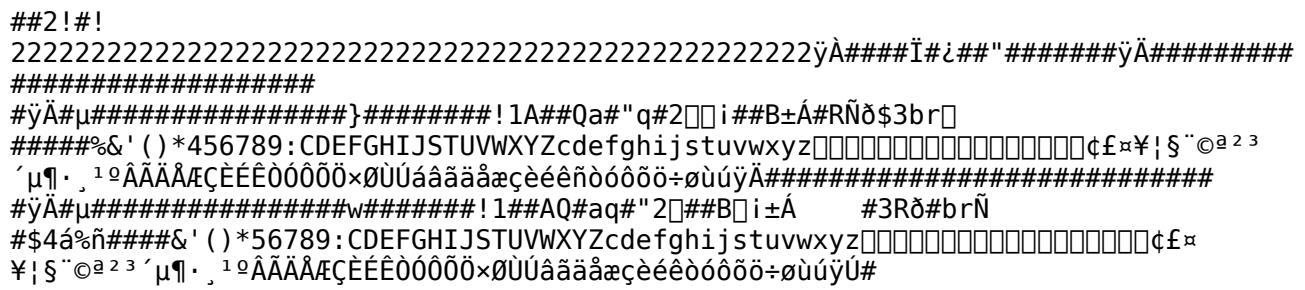

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#######ð####]#â#C#.###ð,#####□###########¨#ª###

ANSYS models provide reasonable agreement to test data The 30-Mil Diamond Post heat sink appears to have performed the best in terms of efficiency and effectiveness Similar contours are shown with ANSYS as recorded with the infrared thermal imaging camera ANSYS Multiphysics is an effective tool, providing a solution to a complex fluid flow and a temperature solution relating to the fluid dynamics

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#Ö###ð§#####□###########¨#□###Curves dropping is possibly due to the film temperature increasing which in turn decreases the water viscosity and increases the Reynolds number.###ðH#####
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###ðW#####□###########¨#C###100 deg limit imposed after cracking a resistor from local boiling.###ðH#####
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###y######ä###########On-screen Show#########NSWCCD Annapolis##e#####f#
#####È#####################################j################################
##### #######Times New Roman#
###Wingdings#####Symbol#####Default Design#####Microsoft Equation
3.0#####Microsoft Word Picture#####Microsoft Word Document#####Microsoft Excel
Worksheet# ###ANSYS User□s Conference June 10, 1999 College Park, Maryland
Richard Garman A&T Engineering Technologies VECTOR Research Division Machinery
Systems Department#####Introduction & Background#####Introduction &
Background#####Introduction & Background#####Introduction &
Background#####Modeling Approach#####Laboratory Test Facility#####Experimental
Approach#####Experimental Testing#####Experimental Testing#####ANSYS
Modeling#####No Slide Title#####No Slide Title#####No Slide Title#####No Slide
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#0#0#6#0#5#2#0#4#C#A#9#A#}############################################cationsPEBB
1 and 1.5 modules have been designed for direct water contact with aluminum
nitride module baseplates##i#
###µ#####³#####l#######Z#µ##########ó#####U####################□###########¨##
###Introduction &
Background##i######################□###□###########¨#¶###Problems with PEBB
baffled heat sinkInsufficient and uneven coolingHigh cooling water pressure drop
Problems with PEBB copper spongeDifficult attachment of spongesCost
Corrosion##i#□###%#####³#####l#######A#####□#####Ø#############!
#####³#####l#######/#####□#####Ø###$################@#################"########
#/##########ó#####□###########)#########□###########¨#####Introduction &
Background##i######################□###□###########¨#Ì###Heat Sink Models
Presented in PaperOpen ChamberedBasic-Channeled30-Mil Diamond PostChanneled with
Pegs (modified PEBB 1)Note: Several Other Heat Sinks were Tested and Modeled
under the PEBB
Program.##i#f###$#####³#####l#######Z#####□#####Ø###P#####³#####l###############
#########Y################P##########ó#####□###########*#########□###########
¨#####Modeling Approach##i######################□###□###########¨#!###Modeling
was conducted in conjunction with laboratory testing2-D CFD analysis conducted
using area models of each heat sinkHeat transfer described by empirical
relationships developed from test data3-D FEA conducted using solid models of
the test heat source - Thick Film Resistor
(TFR)##i#####"#####³#####l#######"##########ó#####□###########,#########□######
#####¨#####Laboratory Test Facility##i######################□###□###########ª#
##############ó#####□###########+#########□###########¨#####Experimental
Approach##i######################□###□###########¨#####Thermal impedance (ºC-
cm2/W):##i#2#############################
##########################ó#####
#####################□###########¨#####Experimental
Testing##i######################□###□###########¨#0###  Thick Film Resistor
provides approximately uniform heat sourcePrinted on 96% aluminaR = 12.5 ohms
Approximately same size as heat sinksConstant resistivity with temperature
Constant emissivity with temperature  Mount in PEBB 1 module housingReadily
available componentsMounts easily to heat sinks##i#
¢###A#####³#####l#######P#□#####Ò#####Ø###P#Z#!
#####³#####l#######9#####Ò#####Ø###P#Z#########>################□#############
############################9##########ó#####V#####################□##########
#¨#####Experimental Testing##i######################□###□###########¨#Ù###
Supply water:Tested over range of flow rates from 0.5 to 3.5 GPM3.5 GPM not
achieved in all tests due to pump limitationsTemperature maintained at approx.
20 ºC by chiller  Resistor power:Varied at each flow rateMaximum 1 kW from power
supplyResistor temperature not allowed to exceed 100 ºC  Data recorded at each
test state:Water flow rate and pressure dropWater input and output temperature
Resistor current and voltageTemperature distribution over
resistor##i#Ò#########³#####l#######Z#i#####Ò#####Ø###P#P#######³#####l#######Z#
j#####Ò#####Ø###P#P#$#####³#####l#######Z#□#####Ò#####Ø###P#P#################
i###########################j################"#########□##########ó#####□#####
######/#########□###########¨#####ANSYS
Modeling##i######################□###□###########ª#
##############ó#####□###########0#########ó#####□###########1#########ó#####□##
#########2#########ó#####□###########9#########□###########ª#
###############□###########¨#g###Modeling Liberties (Assumptions):Water
temperature held constantVelocities were applied in one directionConstant
thermal conductivity of TFR substrateNeglected thermal conductivity of the
resistor filmAssumed TFR substrate material is isotropicAssumed uniform heating
of TFRNeglected surface radiation and convectionNeglected effects of PEBB 1
housing##i#V###"#####³P####l#######F#2#
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Conclusions##¡####################□####ð¤#####
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##ó##ðZ###□#####□#4áv#□#«g##□#Ö³##□#«g##□#Ö³##¿#####□#####□#####¿#####À#####Ë#□1
##ÿ###   #######?########ð####]#â#C#.###ð######□###########¨#ª###   ANSYS models provide reasonable agreement   to test data   The 30-Mil Diamond Post heat sink appears to   have performed the best in terms of efficiency and effectiveness   Similar contours are shown with ANSYS as   recorded with the infrared thermal imaging camera   ANSYS Multiphysics is an effective tool,   providing a solution to a complex fluid flow   and a temperature solution relating to the   fluid dynamics
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